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Organization of Agricultural Resource Information

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A POLICY PROPOSAL FOR THE ORGANIZATION OF AGRICULTURAL RESOURCE INFORMATION

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FORWARD

RESOURCE INFORMATION, COMMUNICATION AND PLANNING

A sound understanding of the resource base is an essential ingredient of good rural planning. The lack of availability of resource information in useable formats causes continuing problems in rural planning. The long-term solution is to ensure, through co-ordinated efforts, that the required resource data is being collected by the appropriate specialized agencies. The data must be interpreted by knowledgeable specialists into formats that communicate the essential information to the users-farmers, businessmen, government officials and planners.

Co-ordination between the specialists who collect resource data and those using this data is essential to ensure the necessary data is being collected and interpreted and is available to users in forms that effectively communicate the required information.

This paper will outline efforts now underway in New Brunswick to improve the resource information system to effectively communicate resource data to those who need it for rural planning at all levels: the farmer, the rural community planner and the provincial policy makers.

The paper will focus on:

1. Means of tying resource inventory data to land ownership through survey monuments co-ordinates, computerized land registration and cadastral maps on orthophoto bases;
2. Fast updating of resource data using automated interpretation of remotely sensed data tied to the survey and mapping system;
3. The use of interpreted maps of resource data (eg. soil suitability) using CanSIS and integrated to the mapping system;
4. The overlay and parameter selection and measurement of resource information of various types;
5. The integration of socio-economic data such as census and field inventory data with natural resource data for planning and policy development.

In today's world, the efficient communication of information is essential to good planning.

The most efficient way of getting a job done is to use the tools which are best suited for that particular job. There is no point in trying to make these tools if they are already available for use. At least in the beginning, when volumes of work are limited in size, there is also reason for using existing tools rather than trying to duplicate them.

EXECUTIVE SUMMARY

Improvements are required in the interpretation, handling and dissemination of information about the agricultural resource base in the province. Improving the efficiency and expanding the land area used for agriculture in the province requires large quantities of good quality, up-to-date, understandable information about soils, climate and land use for crop production. The volume of this type of data is expanding rapidly but the existing organization is not designed to handle such large volumes. An improved agricultural resource information system is needed to support the interpretation and dissemination of field data and to combine data from various sources into formats which are readily understood and useable for agricultural management and policy decision making throughout the province.

An examination of the existing situation has been made and a framework proposed for the development of a system that will produce products in an efficient manner. These products should provide the needed resource base information for decision making in:

1. Farm Management - by supporting the N.B. Agricultural Production Planning Program, and ASA II management requirements;

2. Extension Services - by making understandable, useable soil, climatic and land use information readily available in district offices to support crop production improvements;
3. Regional Agricultural Development - by providing the background information for development decision making; and,
4. Departmental management and policy making - by having background information available for improving technical and scientific services and for the preparation of policy proposals for decision making.

Further efforts are required to determine the types of interpreted information which is most useful and the methods of handling and disseminating this information in an effecient manner.

A framework for carrying out these determinations is outlined in "A Policy Proposal for the Organization of Agricultural Resource Information".

Maximum return for investment in resource data collection and maximum improvement in New Brunswick agriculture can only be obtained if this data is processed into useable form for management decision makers at all levels from farm managers (farmers) to government policy makers.

Policy Summary

Whereas it is the objective of the New Brunswick Department of Agriculture and Rural Development to improve the incomes and employment in New Brunswick agriculture, and,

Whereas more and better information about agricultural resources is needed to attain this objective;

The required policies are:

1. That a system of efficiently collecting, interpreting, and disseminating information be developed: (a) resource information: (i) land (ii) climate; and
2. That this system be designed with the users requirements being of paramount consideration; and,
3. That in order to provide the users needs, the system be designed to transfer the available information to users when required, with the measure of the system being the quality and quantity of information flowing through it and not the volume of information stored in it; and,
4. That cooperative efforts for development and operation be exploited to achieve efficiencies of operation, using wherever possible existing facilities already familiar to those involved; and,
5. That effective means be instituted to update and orient departmental staff and other users to the benefits of relevant information and how to effectively use both the system and the information.

PREFACE

For some years, the New Brunswick Department of Agriculture has been involved in the collection, analysis and dissemination of information about the agricultural resource base, both bio-physical and socio-economic. The volume of information now coming available both as a result of departmental collection activities and from other agencies of government and industry has increased greatly in recent years. Much of this information could be very useful to decision makers at all levels from the farmer to the government policy maker. It has become clear, however, that traditional information handling techniques and procedures are not adequate to handle this increased volume of information.

The purpose of this paper is to provide a policy statement which can be used as a guide to carry out the necessary changes and improvements for existing procedures for handling resource information to meet present and future requirements.

The paper begins by defining the scope to be covered and defining the terminology being used. This is followed by an analysis of the different types of resource information required in agriculture. The origin of data and

manipulation to make it useable by farmers are presented. Some alternative methods for handling and disseminating this information are then examined. The potential products of such a system, their uses and benefits are the conclusion to the paper.

By laying out the various parts of an information system in this report, it is hoped that the many individuals involved will be better able to understand how their efforts fit into the whole picture and how those efforts will benefit the farmers of New Brunswick.

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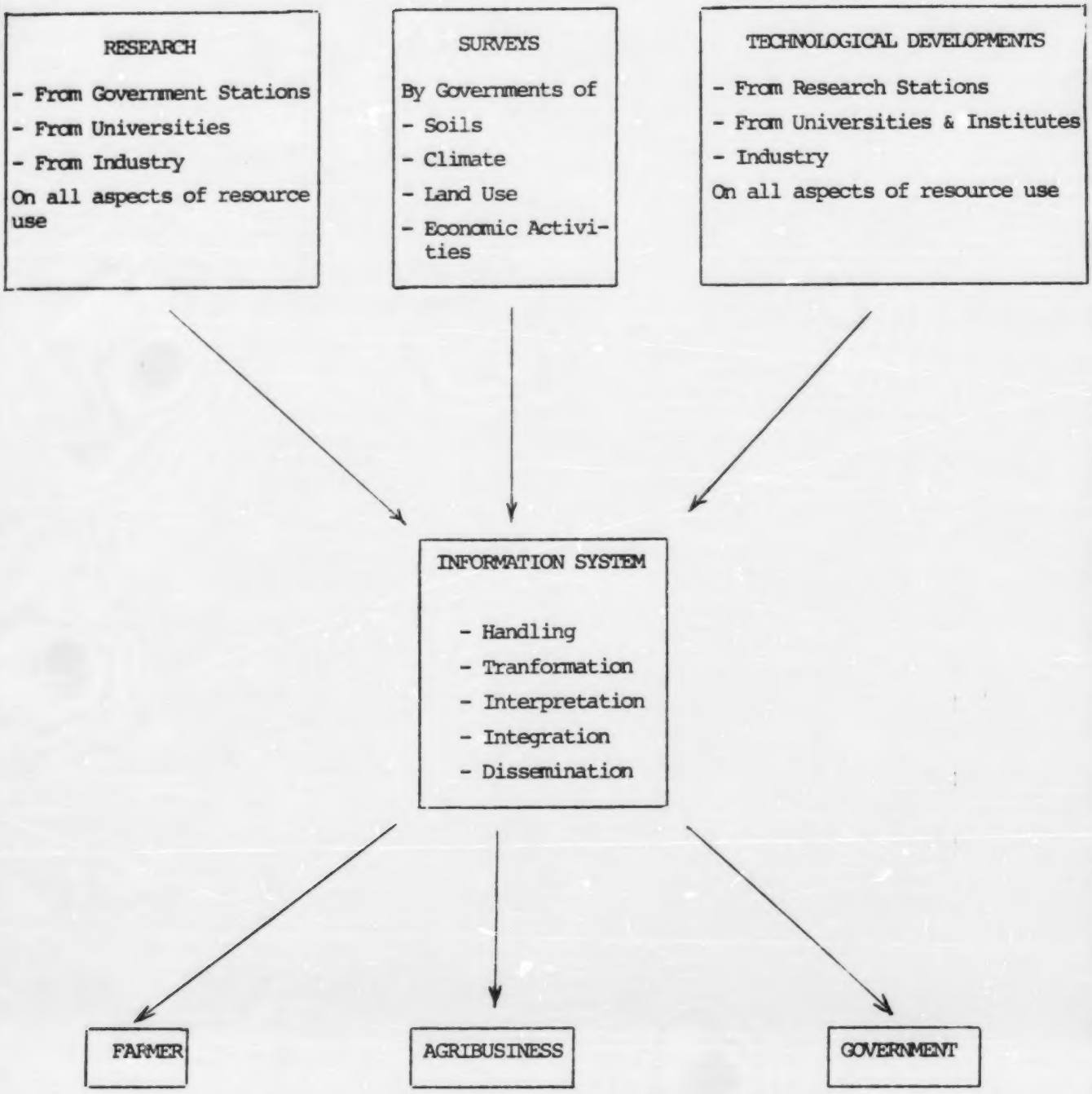
1. INTRODUCTION

Scientific and technological developments have largely changed agriculture from an art which one learned only from one's father to a science which one learns through an education process of both formal schooling and continuing acquisition of knowledge about new developments. To improve his income today, a farmer must continually improve his efficiency to optimize the return on his labour and capital investment.

This knowledge must begin with a good understanding of the physical and biological resource base of the farm. It must continue through the entire production, processing and marketing process. This paper is concerned with the development of an improved system for presenting the needed information about the resource base from those who discover it through research and collect it through inventories to the farmers, business men and government officials who have to make decisions regarding resource usage.

Decisions leading to the optimum use of natural resources in agriculture are made by many people from the farmer to the senior government officials and between. The quality of those many decisions will depend on the quality and/or quantity of the information available to the decision maker. The availability in turn depends on the quality of the system which supplies the information. An improved information system will lead to better decisions being made which will result in more dollars in the pockets of New Brunswick farmers, and better products for New Brunswick consumers.

While this paper is particularly oriented towards agriculture, the principles outlined could be adopted to other renewable natural resource sectors.


RESEARCH
- From Government Stations
- From Universities
- From Industry
On all aspects of resource use
SURVEYS
By Governments of
- Soils
- Climate
- Land Use
- Economic Activities
TECHNOLOGICAL DEVELOPMENTS
- From Research Stations
- From Universities & Institutes
- Industry
On all aspects of resource use
INFORMATION SYSTEM
- Handling
- Tranformation
- Interpretation
- Integration
- Dissemination
FARMER
AGRIBUSINESS
GOVERNMENT

1.1 The Purpose of a Resource Information System

The purpose of a resource information system is to provide an organized and efficient flow of information from researchers, collectors (surveyors) and industry to those people who have to make the decisions about the use of these natural resources. Those decision makers may be farmers, managers of agri-businesses or government officials. The government is often called upon by farmers and agri-businesses to provide information to back-up this decision-making process. The government itself needs resource information to make all of its own policy decisions pertinent and relevant. The better this back-up information, the greater the knowledge of the decision maker and the better the decisions that will be made. This will lead to more efficient use of natural resources and increased income to all those involved in agriculture.

It should be noted that considerable information about natural resources already exists and the development of an information handling system would greatly improve the efficient use of this information. Increases in surveys or research activities should be efficiently handled by such a system when they occurred.

Note that the process being proposed here is a dynamic one, and is not a proposal for the establishment of a data bank. THE TEST OF SUCH A SYSTEM SHOULD BE THE MEASURE OF THE QUANTITY AND QUALITY OF THE INFORMATION WHICH FLOWS THROUGH IT TO USERS AND NOT A MEASURE OF THE VOLUME STORED IN IT.

1.2 Types of Resource Information

The definition of the term "information" in this paper is based on the provincial economic development strategy as it applies to agriculture. Consistent with this strategy, the attainment of maximum economic and socio-economic benefits from the agricultural resources of the Province can be achieved through:

1. identifying and pursuing new or unexploited development opportunities;
2. expanding employment in those existing aspects of the agriculture industry in New Brunswick which enjoy a demonstrated competitive advantage on the provincial or export market; and
3. improving the viability of the existing industry and its ability to sustain growth.

The term "information", as it is used herein, includes anything which will improve the knowledge of those people working in any aspect of agriculture in the Province, and which will assist them in making decisions, solving problems and overcoming limitations of the natural resources to achieve optimum output.

For purposes of discussion, information will be considered under four general categories:

1. soil information is any information relating to that material which supports the crops, and supplies them with nutrients and water, including topography (slopes), texture, depth to solid material and various other physical and chemical properties which effect plant growth;

2. climatic information includes the availability of heat and moisture to plants, lengths of growing seasons, sunshine availability, etc.;

3. land use information includes the way that land is being used and how these uses change over time, how the land is divided by ownership and fields; and

4. socio-economic information about the existing farmers, farm operations, the supporting agri-businesses, inputs and outputs, economic viability and potential for future economic development.

While these four general categories are convenient refernces, it is usual in decision making that information from more than one, and often from all categories, is required at the same time. An essential part of any information system is, therefore, the integration of various types of information and its interpretation into forms that can be understood by all those involved in its use.

1.3 Present Means of Information Transfer and Its Limitations

The traditional method of transferring results of research experiments and surveys is by publishing articles in journals or reports, with maps where required. While they are of interest to specialists in their respective fields, many of these reports and maps need further interpretation to become useful to the non-specialist. For example, when a soil survey has been made of an area, a report and map are compiled. These maps have usually been published on

large sheets of paper in many colours and covered with many symbols. The process of publishing such reports requires at least a year and often two, three or more years. During this time, the information which has been collected is not available to those who need it. Even when published, it is necessary for a user to spend considerable time to learn what symbols are used and how they can be interpreted for use. Very often potential users, busy with other tasks, do not have the time to go through the lengthy process required. It is often necessary also to reproduce parts of maps at different scales so that they can be used along with other data. This problem also occurs with many other types of information. The result is that much natural resource information gets shelved and the benefits which might have been derived are lost. This greatly reduces the efficiency of operation and often means that decisions are made by "guess" rather than based on sound information.

These limitations have been recognized by many of the information producing agencies and changes are being made. These will be referred to below.

1.4 Requirements for Improvements

In order to achieve maximum useage and benefits for the efforts put into research and resource surveys, it is necessary that the information received by the users has been given practical interpretation and is in a format that is readily useable. The following criteria are suggested as guidelines for carrying out this interpretation and transformation process:

1.4.1. AN INFORMATION SYSTEM MUST BE DESIGNED WITH THE USERS REQUIREMENTS BEING THE PARAMOUNT CONSIDERATION.

1.4.2. The format in which the information is presented must be designed so that it can be used with the minimum of expenditure of time and effort on the part of the user. The degree of interpretation, use of specialized scientific jargon and symbols should be designed for the user. This may mean that some information may have to be presented in different ways for different users. What is useful to an agrologist may not be meaningful to a farmer or a regional planner.

1.4.3. Procedures for handling and disseminating information, as well as formats, must be standardized as much as possible. This serves the two purposes of making the process more efficient and making the products more readily useable. For example, maps should be produced at a standard scale, or multiples of that scale to make comparisons as easy as possible.

1.4.4. Interpretations of the basic data should be carried out where possible by those people who produced it as they are most familiar with it, understand it best and can, therefore, make the interpretations most quickly and efficiently.

1.4.5. The types of interpretations which are prepared should be chosen in consultation with the users as much as possible to ensure that maximum use will be made of the information.

1.4.6. Where information is of a type not previously available, its introduction must be accompanied with the necessary training of users to ensure that the maximum benefits are derived from the efforts expended to develop and/or collect it.

1.4.7. Where certain combinations of information are routinely required for decision making, the combinations should be readily available. An example of this would be the combination of soil and climatic information for selecting the optimum crop rotations for a particular farmers situation.

1.4.8. The time between the development and/or collection of information and its availability to users must be minimized. Considering the large volumes of information required for modern agriculture, this indicates the utilization of automated data handling equipment to achieve efficiencies of operation.

1.4.9. Many organizations, both governmental and private have already developed both the machinery (hardware) and the methods (software) necessary to do many of the tasks required. Careful consideration should be given to using existing agencies and systems where they will do the job. There is no need to "reinvent the wheel". It must be remembered, however, that the requirements of agriculture do not necessarily match those of the agencies who have systems in operation. The ability to adapt existing systems and to develop new ones where required must be a part of any information system development.

1.4.10. Information is dynamic. The continued changes in the information available and the requirements of users mean that an information system must be flexible and able to adjust to new situations as required.

1.5 Benefits of a Good Resource Information System

THE ULTIMATE BENEFICIARY OF ANY GOOD RESOURCE INFORMATION SYSTEM MUST BE THE FARMER. This benefit may be direct, with the information being available to the farmer, or indirect in the form of advice from the district agriculturists or agronomist. Good resource information is also required for the establishment and adjustment of government policy related to agricultural development.

1.5.1. Improved soil information can lead to better land husbandry, including the selection of management techniques to reduce soil erosion at minimum cost. Soil interpretation and slope maps can reduce the time and effort required for the preparation of plans for soil erosion control works such as terraces and waterways. Where erosion is less severe and structures are not required, erosion can often be controlled by good crop rotation, which depends on good soil information. Combined with the use of appropriate soil amendments and fertilizers such improved management can optimize long term crop yields, and therefore farm income.

1.5.2. Improved climatic information can assist the processes referred to above by improving the selection of appropriate seed varieties for the particular situation on the individual farm. Climatic information is also important in selecting appropriate planting dates and for determining optimum pest control activities such as spraying. By lowering costs and increasing yields, the farmer can increase profits.

1.5.3. Improved land use information is very important for regional planning and development both by the Department of Agriculture in establishing regional development policies and by District Planning Commissions. When compared with soil and climatic conditions, it is possible to determine if a region is being used near or below its potential level of production, and therefore, whether or not it has potential for improved production given the necessary management.

1.5.4. Improved socio-economic information is necessary for the selection of the most appropriate development policies. Where regions have the necessary biophysical requirements for greater production but are not currently producing near optimum levels, the analysis of the socio-economic information about that region should identify the weak points, where

increased efforts on the part of both government and private sectors will lead to increases in production and profits. In addition, such information can be used to improve the measurement of the effects of current government policies and to analyze the potential effects of changes in those policies. Numerous economic models have been developed to carry out such analyses but they are dependent on good quality and readily accessible inputs.

2. THE EXISTING RESOURCES - AGRICULTURE IN NEW BRUNSWICK

This section provides a brief description of the existing resources of New Brunswick which form the basis for agricultural activities. It points out some of the limitations to agricultural development resulting from these limitations and suggests some of the activities which are necessary to overcome them.

2.1 Resource

2.1.1. Topography and Soils

The land surface of New Brunswick is the result of a series of glaciations over a base of mixed bedrock types. The result is a surface which does not have large differences in elevation but has many frequent small differences. This hilly surface results in the areas suitable for agriculture being divided frequently by rock outcrops, rough surfaces, gullies and valleys and shallow depths to bedrock or hard layers. The glacial history has meant that most soils have formed on either glacial tills or glacial outwash material with some small areas of recent alluvium. This means that soil types vary frequently over small areas and drainage patterns are varied and often not well developed.

When this type of land surface is used for agriculture the result is frequently small fields, which often contain more than one soil type and frequently require drainage to make them uniform enough for economic cultivation. This means that the New Brunswick farmer begins with a built-in disadvantage when compared with many other parts of Canada. His costs for land development are frequently high compared with those in southern Ontario or the Western provinces. These costs may be for such items as installing drainage tiles, removing hedge rows or brush between small fields, levelling and filling of gullies, removing stones, constructing erosion control structures such as terraces or stream bank protection and the building of waterways to carry off excess water so that it does not cause erosion. In areas of interval lands and marshlands, it may mean the construction of drainage ditches and dykes as well as land forming to make cultivable areas suitable for today's large machinery.

2.1.2. Climate

Although the growing season in New Brunswick is short, this is somewhat compensated for by the long daylight hours of summer. The Maritime climate, while having moderate temperatures, also has the effect of limiting bright sunlight hours when fog occurs in some coastal areas. The result is a climate which is excellent for temperate crops such as strawberries and blueberries but which is near the limits of growth for some forage and corn crops. The development of new hybrids in recent years has extended the range of some crops but care must be taken to select those varieties suited to the particular farm. The hilly topography creates frequent variations in micro-climate. The warmest temperatures and longest growing seasons occur on south facing slopes. Hill tops tend to have lower temperatures and are often more exposed to potential wind damage. Valley bottoms may have short growing seasons due to the drainage of cold night air into them. The best climate for agriculture is found along the Saint John River Valley from Gagetown - Grand Lake area to north of Fredericton with heat and season length decreasing northward and on hills surrounding the valley. The Fundy coast, while having a relatively long season, suffers from only moderate temperatures. Conditions along the east coast through the northeast are intermediate of these two. The northwest has a more continental type climate with less maritime effect. While climate does put limitations on the choice of crops and varieties that can be grown there is still considerable opportunity for agricultural development but care must be taken to adjust farm management decisions to the climatic situations as they exist on each farm.

2.1.3. Natural Vegetation

The natural vegetation of New Brunswick is forest. It is classified as "Southeastern Mixed Forest - Acadian Forest". It varies from areas of predominantly hardwoods in areas of more favourable climate to spruce fir predominance in some coastal and highland areas. The fact that the natural vegetation of the region is forest means that land must be continually managed to maintain agricultural production. Without continuing attention, pasture lands soon revert to their natural forest cover.

The combination of geological history, climate and natural vegetation has resulted in most soils being

acidic in nature and requiring periodic applications of lime to keep them in a pH range suitable for agricultural crops. This again adds to the cost of farming in the province.

2.1.4. Land Tenure

When the first settlements took place in New Brunswick, the only easy method of transportation was by water. As farms were created in the forest, it was necessary that each farm had at least some access to water for transportation. As road transportation became common, the roads were built where construction was simplest, which tended to be up the smaller river and stream valleys or along the tops of ridges. Again, farms were designed to have access to the road system. This meant that the common farm shape in New Brunswick is a long narrow farm with one end on a road, river or stream, and the length of the farm extending into the hills back from the valley or onto the rough land away from the ridge. Many problems have resulted from farms being bisected by roads. In the days when the family farm, with horses for power, produced most of what they needed and a little extra for cash this arrangement was very good. It gave each farm a level area, often with some alluvial or interval land near the river or stream where the garden could be located, an area of gently sloping land for crop production, becoming more hilly but still suitable for hay production. The hilly areas away from the water or road provided wood for construction, heating and sale.

The advent of mechanized agriculture with tractors and machinery which worked best on long fields with few turns left many of the traditional farms poorly laid out. It is more efficient if the interval lands can be farmed in long strips parallel to the river, but land holding patterns thwart this type of management.

As populations grew and many farmers left the farm for urban areas, a certain amount of consolidation took place and more efficient field patterns have been created. This is more true in those areas of the province where agriculture has been most viable, such as in the upper Saint John River Valley. This process of consolidation is least developed in the east and northeast where the move from the farm to the cities has only taken place since the 1950's. In those areas, the old farm and field patterns are still very prominent. A cultural force which has

worked against this process of consolidation is the ties people feel to their homeland. Even though they now live in the city, many land owners prefer to retain ownership of the old family farm just in case they decide someday to return to it. While the land might be rented to a nearby farmer, these are usually on verbal short term arrangements and the user does not invest in long-term developments. This practice makes it more difficult for those farmers who remain to consolidate their fields into shapes and sizes more suitable to modern agriculture.

2.1.5. Recent History

The number of farmers in New Brunswick has greatly decreased in the past half century or more, as has the acreage of land under cultivation. There are many reasons for this which are beyond the scope of this paper but are well documented elsewhere. The recent history of agriculture in the province was well documented in the Report of the Agricultural Resources Study 1977. In spite of declines in numbers of farms and acreages, the physical volume of agricultural production has remained relatively constant over the past 25 years (when yearly variations are averaged out). This is the result of those farms which remain having become larger and more efficient. Along with the decline in the number of farms went a decline in interest toward agriculture as a means to "the good life". The number of people training in agriculture remained low and available training opportunities declined. This situation has begun to reverse itself in recent years, however. The reasons for this are varied and complex and explanation will not be attempted here. It is safe to say that renewed interest exists on the part of farmers, farm organizations and governments to improve agriculture in New Brunswick. (Ref. Atlantic Agriculture: The Billion Dollar Challenge). The Maritime region has grown in total population during this period when agricultural production has remained relatively constant in volume. The extra food requirements have been met by imports. While some imports cannot be replaced, for example tropical fruits, many can.

There is a market waiting for home-grown vegetables, fruits, grains and meats. Growing these products is only the first step. They also require storage, handling, transportation and marketing.

2.1.6. Constraints and Advantages

Many of the factors referred to in the five preceeding sections are constraints which limit the development of agriculture. At the same time, many of the strengths have also been referred to. It is easy to speak of these constraints and advantages in such general terms, but quite another thing to specifically point to just where they are located in the province. Which products are most in demand? Which fields and farms, and farmers are best suited to fill these demands? The answers to these questions require considerable understanding of how the whole agricultural and food producing industry operates. This requires an efficient and available information system.

2.2 The Structure of Agricultural Production Activities

The process of food production may be simplified into the following model. The natural resource base in acted on by farmers to produce products which must be handled, processed, stored and marketed to provide jobs and income to those involved. Each stage in this process requires tactical management information. This is illustrated in the accompanying diagram.

How this process can be influenced, and in which ways, will be considered next.

2.3 Improving Agricultural Production

2.3.1. The policy of the New Brunswick government is to maximize income and maximize employment in all sectors of the agriculture and food production process in the province.

2.3.2. To do this, it is necessary to increase either the price or the volume of production of crops grown in New Brunswick.

2.3.3. The demand for food by New Brunswick consumers is met only in part by New Brunswick producers. The remainder is imported.

The Agriculture - Food Producing Process

Associated Information Sources

NATURAL RESOURCES

- Climate
- Soil
- Water

RESEARCH

- Universities
- Governments
  - Federal
  - Provincial

INVENTORIES

- Governments
  - Federal
  - Provincial

FARM PRODUCTION

- Cropping
- Livestock
- Buildings
- Machinery
- Capital
- Management

AGRIBUSINESS

- Seed cos.
- fertilizer cos.
- Chemical cos.
- Real Estate Agents

UNIVERSITIES

- Research

GOVERNMENTS

- Federal research
- Provincial Inventories Extension

P R O D U C E

MARKETING

- Handling
- Processing
- Transportation
- Storage

THE FOOD INDUSTRY

- Wholesale
- Retail
- Processors
- Shippers

THE MEDIA

- Market reports
- Extension

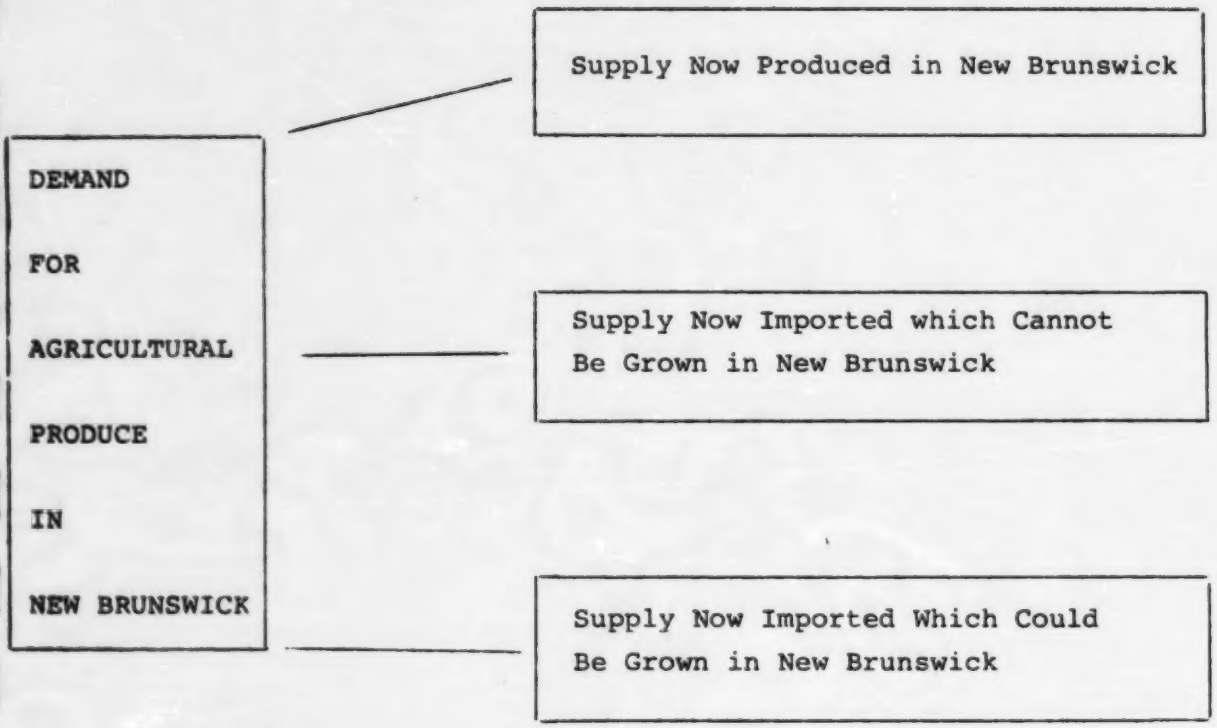
UNIVERSITIES

- Research

GOVERNMENTS

Fed. and Prov.
- Research
- Control
- Extension

I N C O M E A N D J O B S


DEMAND
FOR
AGRICULTURAL
PRODUCE
IN
NEW BRUNSWICK
Supply Now Produced in New Brunswick
Supply Now Imported which Cannot Be Grown in New Brunswick
Supply Now Imported Which Could Be Grown in New Brunswick

The main reason why many products are not now grown locally is economic. The food wholesalers, and as a result the consumers, can buy them from elsewhere more cheaply.

A number of changes are now taking place, mostly due to the increases in the price of petroleum products and the accompanying increases in transportation, which are putting local produce in a more competitive position.

Wholesale price is only part of the costs of buying imported food. Dollars which are paid out for imported produce are lost to the local economy while dollars paid to local farmers, processors, handlers and storers of locally produced foods remain in the New Brunswick economy increasing incomes and employment. (The Report of the Agricultural Resources Study 1977 estimates the employment multiplier in New Brunswick agriculture is 5.6 and the income multiplier is 3.0).

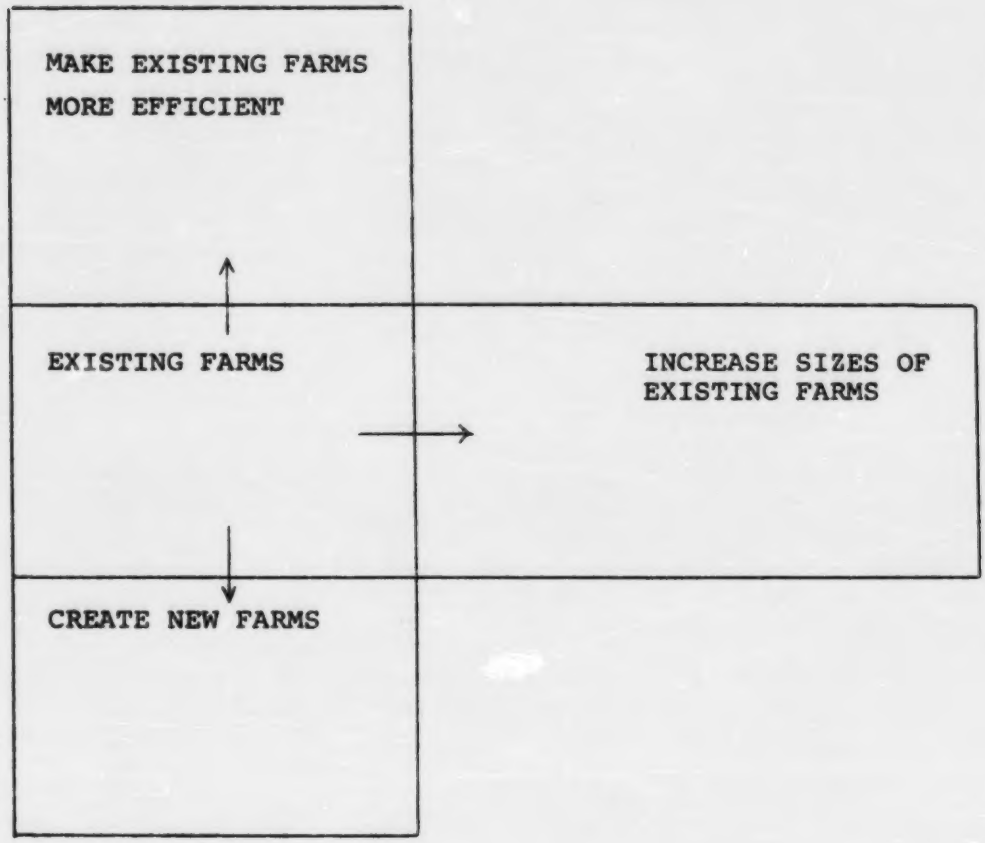
2.3.4. The selection of those crops and products which can most immediately and effectively replace products now imported must depend on a combination of the ability of those products to compete in the marketplace and the ability of New Brunswick farmers and resources to produce those products efficiently. Production efficiency is a necessity if incomes and employment are to be maximized.

2.4 Methods of Increasing Volume of Agricultural Production

The volume of production in New Brunswick may be increased in three main ways, and/or a combination of any or all of them. (See diagram on next page.)

2.4.1. Making existing farms more efficient by using improved seeds, better fertilization, more efficient use of machinery and overall better management.

2.4.2. Increasing the size of existing farms by bringing abandoned land into production, clearing forest land, draining and improving marginal land, and by having existing farmers buy land not now being used by present owners.


MAKE EXISTING FARMS
MORE EFFICIENT
EXISTING FARMS
INCREASE SIZES OF
EXISTING FARMS
CREATE NEW FARMS

2.4.3. Establishing new farms by training young people to farm and assisting them to buy and finance new farms or by bringing in trained farmers from outside the province.

2.5 Identifying Constraints to Increasing Production

2.5.1. The improvement and expansion of agriculture is constrained by the limits set by the natural resources of a region (e.g. it is not practical to try to grow bananas in New Brunswick). These limits can be stretched by the application of modern technology but there are practical physical, biological and economic limits to the extent of this stretching.

2.5.2. Areas where the existing constraints are minimal or are easily and inexpensively overcome are where the potentials for increasing production are the greatest. Where overcoming constraints cost too much the farm income is reduced. It is therefore imperative to be able to identify those regions, farms and fields of the province which have the minimum constraint problems. This requires a knowledge of potential of land to produce the desired crops with the use of technology and management levels now available and likely to be available in the near future.

2.5.3. The required knowledge must relate to all aspects of production, including the natural resources, the existing levels of technology, and the existing human resources such as manpower, education, marketing, etc.

2.5.4. The quantity of information involved in these fields is so great that it is impractical for any one person to try to keep up with it all. Decisions must often be made not on a manager's personal knowledge of all the details involved but on the basis of the interpretation and evaluation provided by specialists in the different fields involved. In agriculture this often means the professional staff of the Department of Agriculture providing information to both the Departmental management and the farmers through the extension service.

3. INFORMATION REQUIREMENTS FOR AGRICULTURAL EXPANSION

Information in agriculture comes from two main sources. The first is the result of research and technological development. This type of information is usually universal as it is not tied directly to a geographic location. This type of information is very important and must be considered in evaluating the potential for agricultural development. Methods for dissemination of this type of information are relatively well developed and are not the object of this paper.

The second type of information is of a geographical nature, directly related to the location of resources on the ground. This information comes from surveys and inventories already done or being done by both federal and provincial agencies. This type of information is the focus of this paper. Consideration is also being given to products of the analysis and evaluation of inventory data which are not now being used but could be useful in the future. The types of information being collected will be outlined in Section 4.

3.1 Information Collection

Because of the nature of natural systems, it is more efficient in many cases to collect resource information over relatively large areas of land. In other cases, studies may be confined to individual farms or farm fields.

3.2 Organizing Resource Information

Regardless of the way in which resource information has been collected, it should be equally available to users. This requires an information system that keys the data to the geographical location it refers to. When soil samples are taken by a farmer and sent to the Department of Agriculture for testing, the results should be recorded by location so that over time a picture of the soils of an area can be assembled.

3.3 Collection of Information Over Time

Much information has been collected over the years and is stored away in various government files. Most of it is not used because it is so difficult to access and understand. For example, a knowledge of the history of soil amendments used on a field over many years combined with crop yields would allow for the improvement of advice which District Agriculturists could provide to other farmers who have similar types of soil on their farms.

4. SOURCES OF AGRICULTURAL RESOURCE INFORMATION

4.1 Research

The results of research from a variety of fields are required by farmers and agricultural professionals. Not being specialists in the many fields from which they require information, the resource managers often require interpretation of research data before it can be useful to them. Also, there is often a question as to whether or not the results of laboratory or plot tests can be duplicated in an economically productive situation.

4.1.1. Interpretation

In those areas of research where the results can be sold by industry, the role of interpreting research data into practical on-farm uses is often taken by agri-businesses. In the resource use area, however, where there is no potential for profit making, this role is usually left to governments.

4.2. Inventorying of Natural Resources

While research advances, our understanding about the operation of natural systems, and technological developments give us the tools to utilize those natural systems to our advantage, it is still necessary to go out into the field to measure and record the types of natural systems which exist in any geographical area. The two basic natural (bio-physical) resource inventories which are most directly useful in agriculture are:

4.2.1. Soil surveys which classify soil types according to a variety of criteria related to how the soil might be used and once classified, illustrate the locations of the various types on maps, and

4.2.2. Climatic surveys which measure meteorological phenomena at specific sites over extended periods and extrapolate that data over the intervening areas. Because of the nature of climate, this process is much more time consuming and the results tend to be expressed in terms of probabilities of occurrences.

Both of these types of inventories are being carried out by both federal and provincial government agencies. In both cases, the processes of data handling are becoming increasingly automated. This will be discussed in more detail below.

4.3 Inventorying of Social and Economic Information

Expansion and development of agriculture depends on the farmers who carry it out, their capability to manage their farms, the communities they live in, the availability of agribusiness support for both inputs and marketing and the availability of capital to invest in their businesses.

Planning for agricultural development requires a knowledge of who owns the land and whether it is being farmed by the owner or a tenant. Expansion costs depend on the availability of cleared land and its quality and the quality of land which is located near a farm for clearing or other improvements. While the location of the infrastructure of agribusiness such as the availability of machinery and parts, transportation and storage facilities, feed and seed supplies, etc., has not traditionally been collected on a geographic basis, the increasing importance of these factors to agriculture warrant careful consideration of including them in an information system.

5. EXISTING INFORMATION

5.1 From Natural Resource Inventories

5.1.1. Soil surveys have been carried out for many years by federal soil surveyors and in recent years by provincial soil surveyors also. Some of these are reconaissance surveys at the scale of 1:250,000 which are too general to be useful for agriculture. Some of the older surveys are of questionable quality by modern standards and at difficult scales. Surveys done by the federal government in recent years and now in progress are being done at a scale of 1:50,000 which can be used for agricultural purposes.

Soil surveys which have been done by the provincial government are more detailed, being at scales of 1:25,000 and 1:10,000.

A list of these surveys, the areas they cover, their scales and ages is included in the appendix.

Each of these survey maps is accompanied by written reports and tables of data.

5.1.2. Climatic Surveys - Climatic information is derived from the analysis of meteorological data collected over long periods of time. Some analysis of this information is carried out by Environment Canada to produce generalized climatic maps. Maps of micro-climate which are particularly oriented towards agricultural requirements are being prepared by the New Brunswick Department of Agriculture agro-meteorologist/climatologist.

A detailed list of climatic maps of interest in agriculture is included in the appendix.

Among the climatic maps now being prepared are maps showing the probability of frosts at spring and fall and the resulting growing season lengths, and the availability of warmth for plant growth, measured as corn heat units and degree days. These are based on the short term collection of data for specific agricultural areas as well as long-term data. Statistical procedures have been developed to allow for the use of short term data for small areas by comparing it with the long-term data.

5.2 From Social and Economic Resource Inventories

5.2.1. Land ownership - This information is publicly available in registry offices but has only recently been put into a readily available map and computer listing format by the Land Registration and Information Service (L.R.I.S.). The southern and eastern parts of the Province is now available in this format. The maps of the north are now in preparation and the western part should be coming available in the next few years. These cadastral maps are drawn on top of an orthphoto (rectified aerial photo) base at a scale of 1:10,000. The orthophotos make it very easy for people without training in map use to readily identify properties. Information about ownership can be obtained through a property identifier number (P.I.D.) which is keyed to computer records. These may be accessed from printout books, micro-fiche or terminal access.

5.2.2. Land use maps - Land use maps are being prepared from data collected by a cleared land inventory project (in co-operation with Canada Manpower and D.R.E.E.) in the summer of 1979. These maps will show the crops grown in that summer including pasture, orchards, christmas trees, farm woodlots and the location of land improvements such as drainage and terracing.

Other information about farms was also collected, this included: a) types and numbers of livestock, b) the extent of rented land used for agriculture, c) type of ownership (family or corporate farms) and d) labour employed on farms.

Certain other personal information has been collected but due to its confidential nature, it will only be publicly available in aggregated form for regions.

Some other information is available for areas from Statistics Canada, Agricultural Census, but this information is only useful for large areas.

5.3 From Industry - Technological Information

Information which must be available when evaluating agricultural land for new uses includes a knowledge of what practical technological procedures exist to overcome the existing limitations. These include engineering technological developments such as new methods of land drainage, deep tillage, cultivation techniques, etc., including the potential availabilities of the necessary machinery in New Brunswick.

Developments of crop technology such as new plant varieties, chemical and biological pest control, etc., must also be included in any evaluation procedure.

Introducing these factors into the land evaluation process will usually require the participation of specialists in these fields participating to some extent in developing the evaluation process. While one person may co-ordinate such evaluations for an area, they must be the results of consultation with a number of specialists from different subject areas.

This type of information will also be useful to appraisers evaluating farm prices for purposes of sales, loans and grants.

6. THE INTEGRATION OF NATURAL RESOURCE INFORMATION

6.1 Need For Integration of Natural Resource Information

Crop growth is dependent on many resource factors being available in appropriate proportions for sufficient periods of time. Inadequacy in any one of these factors will effect plant growth. Identifying the factors which are limiting growth require not only studies of the individual factors but also how these factors work together.

A similar situation exists with the operation of a farm business. To obtain overall efficiency of production and maximum income, it is necessary to have efficiencies in all parts of a farm operation. Since many parts of an operation may be dependent on other parts, it is necessary to understand not only how the parts work but how they are integrated. For example, to maximize the benefits from the investment in the latest type of dairy barn and milking equipment, it is necessary to have highly productive cows. This, in turn, depends on the quality of feed they are receiving which depends on soil management and feed storage procedures.

6.2 Integrating Topographic, Soil and Climatic Information

6.2.1. The base map on which most natural resource information is collected is the topographic map. This provides the key to the location and relationship of various units of land whether they be fields, farms or agricultural regions. The traditional topographic map produced by the federal government (Energy, Mines and Resources) show landscape features with contours and symbols and cultural features with symbols. These maps are not frequently updated and many are now quite old. A program of updating of these maps for New Brunswick is beginning this year.

6.2.2. The type of map which is proving most useful as a base for natural resource information is the orthophoto map as the location of fields and farms is very easy on the photo base. These maps are now being produced by the Land Registration and Information Service (L.R.I.S.) with contour lines showing elevations and with property boundaries. Orthophotos allow for the quick evaluation of the land quality of an area, its slopes, drainage, vegetation cover, road and communication systems. They are now being used as the base for mapping soils and climates where the information is being collected at that scale (1:10,000). It is expected that they will become the standard base map for land resource information in future.

6.2.3. The soils types in New Brunswick tend to be very complex. This means that in order to map these soils in a way that is useful for farm management, they must be mapped at a large scale. Soil maps now being made by the Department of Agriculture pedologists are using the 1:10,000 orthophoto bases where they are available. Where they are not available, larger scales are being used.

6.2.4. Climatic information is available at a very limited number of stations and the micro-climate of intervening areas must be extrapolated from that information taking into consideration local topography. Where climatic data during the growing season has been collected for a long eough period of time by stations established by the Department of Agriculture, at the required density, the micro-climate is being mapped using the orthophoto map base at a scale of 1:10,000. Where information is available at lesser densities, appropriately smaller scales are being used. The hilly nature of much of New Brunswick farm land makes the analysis of micro-climate complex and time-consuming. Details of what climatic maps are now available and in preparation is included in the appendix. They include maps of frost probability, growing season length probabilities, degree-days and corn heat units.

6.2.5. As crops respond to the combined effects of all factors of the natural environment, it is necessary to put the topographic, soil and climate maps together for purposes of analysis. The farmer too much work with the combined encironmental factors. For example, a field with suitable soil and climate for a desired crop is useless if drainage is so poor the farmer can't get on the field with his machinery until past the required planting date to ensure crop maturity.

6.2.6. The easiest method of examining this large variety of information for a specific area is to have the information on maps drawn on transparent sheets so that they can be overlayed as required on the orthphoto maps which show the fields. This can be done manually or when the data is stored in a computer this "overlay" process can be accomplished by the machiner and the result either displayed on a CRT (TV screen), copied on a photocopy or drawn by a plotter into a complete map.

This type of overlay process, either manual or computerized, must have the flexibility of using any or all layers of information as a situation requires and be capable of incorporating new and updated material as it comes available.

6.3 Integrating Land Ownership, Social Characteristics and Economic Information

Farm management decisions depend on the ability of the farm manager, his background and education and the information he has available on which to base his decision. The potential for regional development depends on both the potential of the natural resources and the aggregate ability of the people in the region to utilize their resources. When evaluating the potential of a region for varying sorts of development, it is, therefore, necessary to integrate information about the people of the region, their qualities, institutions, attitudes, expectations, and management abilities with the economic and bio-physical conditions of their region. The ability to inter-relate all of this information for a geographically defined region requires that this information be tied to a location on a map and defined by co-ordinate values.

6.4 Putting It All Together

6.4.1. Information relating to a specific area of land must be connected to that land by a location key such as a property identifier number or a co-ordinate value. Where possible, the information must be displayed on maps as this provides the quickest way for a user to inter-relate large quantities of information for a specific area. Information not on maps must be keyed to them so that it can be quickly accessed. All types of information must be contained in one integrated system (though not necessarily in the same files). The important factor is the ability to access all resource related information through one system for speed and efficiency.

6.4.2. Such a system must have the capability of allowing for the selection of that information required for a particular situation, and only that situation. This means that information must be integrated and cross-referenced in a variety of ways so that they can be extracted in various combinations of maps and/or texts. (For example, if a new crop or variety is being considered for an area, it should be possible to pick from maps those areas with the characteristics of soil, climate and cleared land most suitable for it and determine whether this suitable area is large enough to warrant further consideration or testing.)

6.4.3. In addition to the capability of integrating information from a variety of sources for a specific site, it is also necessary to be able to aggregate over areas. For example, to be able to total the number of hectares of a particular soil type or crop in a region. The necessary machinery required to do these types of integration and aggregation will be referred to below.

6.4.4. Information changes at different rates depending on its type. While soil information remains relatively constant over many years, crops may change every year. It must be possible, therefore, to update part or all of the information in any system as it becomes available. Each time new information is entered into an integrated system, all other pieces of information connected to that which has been changed should also be changed. It is most efficient, therefore, to have data stored in as elementary a form as possible so that the maximum number of combinations may be made as required, and the minimum number of changes are required when new information is added.

7. THE DISSEMINATION OF AGRICULTURAL RESOURCE INFORMATION

Information is only useful if it is continually flowing from producers to consumers. There is need also for a feedback mechanism to insure that the required type, quantity and quality of information is arriving at the information consumers when they require it. At present, there are information needs not being supplied and available information not being disseminated to those who need it. A brief analysis of the present situation will be made with some suggestions for methods of overcoming these problems.

7.1 The Existing Extension Procedures

The traditional information transfer procedure has been to prepare the results of research, surveys or inventories in the form of written reports, tables and maps. These are printed and passed out a variety of people some of whom may use the information, many may not. Many potential users may not know the information is available.

7.2 Constraints to Expansion of the Present Procedures

Research reports and papers in scientific journals tend to be written for other scientists. They are usually full of specific jargon which is difficult for others to understand. Journals designed for producers may spread generalized information about new discoveries which direct a producer to their sources but there is often a problem with the distribution of the detailed information a producer needs to put a new discovery into practice. Extension staff are providing this role as best they can, but they cannot be experts in all fields and they must be backed-up by specialized support staff. While present support staff are doing their best, there still remains a bottle-neck in the flow of information at this point. These specialized staff are relatively few in number and it does not appear at present that this number will be greatly increased. The alternative to increasing the numbers of staff is to employ modern technology which allows existing staff to be more efficient and to increase the quantity of information they can supply to the extension staff and the primary producers.

For natural resource information to be useful to producers, it must be presented to them in terms that relate directly to productivity and costs. For example, a farmer needs to know if a new variety of crop or a new machine or a soil

improvement practice will pay him a profit on his investment. This means that considerable integration of information must be done before that information is disseminated. When large quantities of data require integration, computerization of the data greatly increases the efficiency of the process. Many procedures (software) are available for doing this with social and economic information such as the "Statistical Programs for the Social Sciences" (S.P.S.S.). In the case of geographic information in map form, the procedures required are more complex and have been slower to be developed but many have recently become available.

7.3 Greater Efficiency Requires Automation

Because they were so costly to prepare and publish, traditional maps usually included as much data as could be presented in a form that was still readible. The user then had to select from this only that data which he required. This often meant tracing copies and changing map scales to integrate information. With computers, each type of information can be extracted separately and combined with other layers from other sources so long as the data has been recorded on a standard reference system. The computer can now do in minutes what required days of manual work. A computer can be used to select that data which applies only to one area of land such as a farm. Use of this machinery can greatly increase the efficiency. In addition to making it possible to provided increased information, automated services can make existing programs more efficient such as, for example, the preparation of farm plans.

8. THE HANDLING OF LARGE VOLUMES OF RESOURCE INFORMATION

A number of agencies have developed data handling systems for geographical data. One is specifically oriented towards soils, another towards land evaluation and land use and a third is oriented towards land tenure. Others handle other types of land-related information. A brief outline of the existing systems follows.

8.1 Existing Agencies Handling Geographic Information

8.1.1. Canada Soil Information System (CanSIS) - Land Resource Research Institute, Research Branch, Agriculture Canada, Central Experimental Farm, Ottawa.

This system has been developed recently to handle the information being collected by soil surveyors across Canada. It is divided into two parts. One is called the Soil Information Management System (CanSIMS) and the other is the soil cartographic file. Soil maps are digitized into computer memoray and the drafting of the final map is done by plotter. Interpretive maps may be produced by this System by the selection of particular parameters. For example, a map showing soils susceptible to erosion classified from severe to slight will be drawn according to those criteria specified by pedologists.

Maps from New Brunswick are now being entered into this system and provincial pedologists are preparing the selection of criteria for interpretive maps.

8.1.2. Canada Geographic Information System (C.G.I.S.) Lands Directorate, Environment Canada

This system was developed to handle the information collected by the Canada Land Inventory. It is designed "to store, to manipulate and to provide capabilities for the analysis and comparison of geographic data". Some improvements have been made recently and the agency is interested in exploring additional uses of the system for resource management. The strong point of this system is its capability to handle large volumes of data on large numbers of maps.

8.1.3. Land Registration and Information Service (L.R.I.S.) Council of Maritime Premiers.

This system is designed to maintain an automated, up-to-date land registration. To do this, it has developed a new survey system for the maritimes and installed a large number of survey monuments. A series of orthophoto maps are in preparation for the province (about half completed) which locate all properties (outside built-up areas where more detailed line maps are used). Each property is identified by a property identifier number (P.I.D) through which additional information about the property and its owner is recorded and easily accessed.

L.R.I.S. orthophoto maps with contours to show elevations are now serving as the base for soil, climatic and land use surveys. Combined with property boundaries and identifiers, it is now possible to tie natural resource information directly to a farm and even to a farm field. Through the extensive monument system, it is possible to precisely locate new land development works such as drainage tiles, terraces, dykes, etc., on these maps.

8.1.4. Maritime Resource Management Services (M.R.M.S.) Council of Maritime Premiers.

This agency provides drafting, planning and job oriented services to the Maritime Provinces.

8.1.5. Canada Centre for Remote Sensing (C.C.R.S.) Energy, Mines and Resources Canada, Ottawa.

This agency has considerable expertise and computerized systems for extracting resource information from remotely sensed sources such as satelite imagery and high and low level aerial photographs of all types. They have been involved in such work with the Department of Agriculture in studies in the potato growing area of the Saint John River Valley and in the coastal areas.

8.1.6. Topographic Surveys, Energy, Mines and Resources Canada, Ottawa.

This agency produces topographic maps of Canada. They have recently begun the drafting of these maps using a computerized system. They are beginning to update existing topographic maps using this new digitizing procedure in the northwest of New Brunswick and will be updating a number of map sheets of the Saint John River Valley in the near future.

Topographic maps serve as base maps for the location of land. While they are used, where detailed information exists, their scale makes them less suitable than the orthophoto maps.

8.1.7. Census of Agriculture, Statistics Canada.

Statistics Canada is now making geographically based statistical data available in computerized form. A computer mapping system known as GIMMS is being used.

8.1.8. Department of Surveying Engineering, University of New Brunswick, Fredericton campus.

This department has considerable expertise in computer cartography and land information systems. They are at present increasing both the hardware and software required for research and development work. In an area which is developing as quickly as computerized geographical data handling and where so much remains to be developed, it is essential to have such capabilities available. While systems are available elsewhere, none has been designed to handle all of the specific types of data required by the New Brunswick Department of Agriculture. Considerable research and development work will be required before an agricultural resource information handling system will be fully automated.

8.1.9. New Brunswick Cleared Land Inventory, Canada Manpower and Immigration, D.R.E.E. under direction of NBDA & RD.

Reports and data on land use, tenure and agriculture in New Brunswick.

8.2 Integration of Existing Agencies Activities to Form A System

Consideration will now be given to the question of whether or not the agencies and systems referred to above can be of assistance to those involved in agriculture in New Brunswick.

As has been pointed out earlier, while the farmer is the ultimate beneficiary of land resource information, his requirements must be recognized by the Department of Agriculture and met as far as possible. Since one of the problems in doing this is the inability to handle large volumes of data, a system designed to do this should, at least in theory, be useful. No single agency can handle all of these requirements but perhaps there are ways to combine the best points of a number of agencies to fulfill the needs.

8.3 Efficiencies in Co-operation - Inefficiencies in Duplication

The most efficient way of getting a job done is to use the tools which are best suited for that particular job. There is no point in trying to make these tools if they are already available for use. At least in the beginning, when volumes of work are limited in size, there is also reason for using existing tools rather than trying to duplicate them.

8.4 The Handling of NBDA Resource Information

The following attempts to outline (in general terms) what might be typical procedures for an improved information system.

8.4.1. Requests for information about agricultural resource base are made by farmers to the extension staff in district offices.

8.4.2. These requests are sent to the specialists in Fredericton. They determine what information is required to answer the farmers questions.

8.4.3. The sources where and how this information might be acquired are also determined.

8.4.4. The types and extent of analysis that will have to be applied to the information is determined.

8.4.5. The ways that this required analysis might be carried out are determined.

8.4.6. The various agencies with capabilities to carry out these analysis are examined and the most efficient procedure is decided upon.

8.4.7. The required information is collected either in the field or from already existing sources and passed on to the agencies best suited for the job.

8.4.8. The analysis is carried out with continual consultation between user and analyst through the Department specialists.

8.4.9. The results of the analysis are put into formats most readily useful to the user.

8.4.10. The analyzed information is returned to the specialist in Fredericton, then to the extension staff and hence to the farmer.

8.5 Management and Special Purpose Requirements

The previous description of information flows to producers was as the system would work "in theory". In practice, of course, certain types of information are required so frequently that it is more efficient to have all the available data processed in the format that is most frequently required. In some cases, this might be information for the entire province while in others, it might be for a region only as required for some project, proposal or agreement.

This type of batch processing of information could be useful for fulfilling interdepartmental and intergovernmental requirements as well as for internal departmental requirements and producer needs.

9. PRODUCTS OF AN AGRICULTURAL RESOURCE INFORMATION SYSTEM

9.1 Farm Management Information

An excellent instrument has been developed by the Agricultural Engineering Branch, New Brunswick Department of Agriculture and Rural Development for using land and climatic resource information in the farm planning and management process. It is called the New Brunswick Agricultural Production Planning Program. The core of this program is a book which contains sections on the physical resources of the farm, production planning records, crop records and production management (financial) records. The physical resource section begins with a blow-up of an aerial photograph of the farm on which are outlined and numbered the different fields of the farm. This number key is then used for the keeping of all records about that field such as the results of soil tests, the history of soil amendments such as fertilizer and lime that has been put on that field, drainage, terracing and/or land forming, and a record of crops and yields. On other copies of the aerial photograph can be shown, the soil types, microclimate and any interpretations that may exist. New resource information can be added to these maps as it comes available. This type of record keeping allows the financial returns to be traced back to the resource base and its management. Continuing analyses of these records by the farmer in conjunction with the District Agriculturist should lead to improved management, greater efficiencies of production and higher profit.

These books are now prepared and records are kept manually. Some farmers may be using automated financial record keeping through Canfarm which would be complementary to this system. The length of time required to prepare the photos and maps for one of these books has limited the rate at which they have been produced. The standardization of soil and climatic maps should decrease the required preparation time. Automation could further reduce the man-hour requirements.

9.2 District Office Information

Farmers who are not involved in the New Brunswick Agricultural Production Planning Program still require information about the land and climate of their farms. In addition to day-to-day management requirements, this type of information is becoming more important in evaluating the economic potential of a farm and its suitability for capital borrowing. The efficient use of capital, whether from private or public funds, requires that the capital be invested in farms which have not only good management but also a potentially productive resource base.

Soil erosion is a serious problem in some parts of New Brunswick, particularly where row crops have been grown continuously on sloping land for many years. Assistance is provided to farmers to help control this problem by improving soil management with such practices as crop rotation and also by planning terracing and waterways where needed. The preparation of these plans by District Engineers and technicians requires information about the soil and climatic characteristics of the area. The standardization of this information and its improvement through research and inventorying can make the planning process more efficient and less time consuming. The introduction of automation for the handling of map information and the carrying out of the necessary calculations could provide further efficiencies and allow existing personnel to increase their output.

For District Agriculturists to be able to put their hands on that information required in specific cases, quickly and efficiently, it is necessary to have the information available in the district office in an organized and current format. The most efficient way of doing this is to have the flow of information to the district offices occurring in standardized formats, rather than each office having to provide its own organization system. As much of the information required by each office is the same, it is more efficient to have this process centralized rather than duplicated in each office. For this reason, a standardized format for natural resource information is suggested.

As both the processes of information collection and information usage are dynamic, this format must be kept flexible and able to be adjusted as the situations require. The following formats are suggested as a way of improving the existing system and making it flexible enough to handle the new forms of information now coming available.

9.2.1. Resource information from research activities being distributed by periodicals and professional journals are not being considered in this system. Any information from these sources which is related to the analysis and

interpretation of data about the natural resource base for that district would be included.

1. Soil Information

Published soil survey reports and maps which have not been prepared to modern standards will remain in existing form unless updating and interpretation are required for particular projects.

Modern soil surveys which have been prepared recently or are now in progress and which follow current quality standards will be processed through the Canadian Soil Information System (CanSIS). The original soil maps and maps of interpretations by N.B.D.A. & R.D. pedologists will be available as drawn by the computerized plotter. These can be either in the form of paper copies or overlays on transparent plastic.

Where orthophoto base maps are available (scale 1:10,000), these overlays can be placed on top of the photo map for quick reference to farms and fields. Prints can be made of all or parts of these combined maps as required for specific purposes. This standard format will be used as far as is practical. In other cases, the maps will be paper line-maps.

By using existing map key numbers, these maps can be filed so they are available for quick reference. Keys will also be available to allow for quick reference to accompanying tables and reports.

The filing system is an integral part of any information system. The ability to retrieve data quickly is essential to the effective use of resource information; and effective use to improve agricultural land management and production is the only justification for the money spent on the collection of the information.

Original soil maps, while they should be available in District Offices, will not likely need to be consulted very often. The important maps will be those showing the pedologists

interpretations of the basic data as it relates to the agricultural usage of the land. Interpretive maps are now in the development stage in New Brunswick. The CanSIS system greatly reduces the effort required to produce this type of map; and interpretations for specific projects can be prepared as required. A number of standard interpretations will be prepared for each map sheet as it is available. These will relate to such subjects as erosion problems, tillage problems, depth to solid materials, soil moisture and others. As more information on crop requirements under New Brunswick conditions becomes available, it should be possible to produce interpretive maps which indicate the suitability of soils and climates for particular crops.

9.2.1. 2. Climatic Information

Climatic information is available at varying levels of detail. Reports are available on the maritime region such as "Corn Heat Units in the Maritime Provinces", and "Spring Field Workdays in the Atlantic Provinces". At the other extreme are micro-climatic maps at a scale of 1:10,000 on orthophoto bases which are now in preparation for those areas where detailed data has been collected. Publications and maps at intermediate levels of detail are now in the planning stages.

It should be noted here that only climatic information is being referred to here. Weather information systems which provide agricultural weather forecasts and related information would continue as a separate system.

All climatic maps and reports should be keyed to the same system used for soil information for quick access.

As detailed micro-climatic maps become available, consideration should be given to combining soil and climatic data to produce interpretive maps related to cultivation and crop requirements.

The types of information referred to here include such topics as frost free periods, mean dates of frosts in spring and fall, heat and sunshine availability and other related information.

9.2.1. 3. Land Tenure Information

Land ownership information is now readily available, or becoming so, from the Land Registration and Information Service (L.R.I.S.). This information is now being produced as an overlay, showing land parcel boundaries and property identifier numbers (P.I.D.) on orthophoto maps. Names and addresses of land owners and certain other information is produced periodically on microfiche. This information can be accessed both by name, alphabetically, and by P.I.D.'s.

This information would be very useful in a District Office for quickly locating farms and other properties. It also provides the key for identification of land belonging to a particular farm. As other natural resource and land use information is being mapped at the same scales on the same base maps, that data can be quickly accessed for any farm or area. Where that information is available on transparent overlays, it can be quickly combined in various ways as required by simply overlaying maps manually. As computer map handling procedures become available, these combinations could be produced automatically for any area required from an individual farm to a region.

9.2.1. 4. Land Use Information

As a result of an inventory of the use of cleared land in New Brunswick made in the summer of 1979, maps are now available or in preparation which indicate crop types and other uses of agricultural land. These are prepared on orthophoto map bases or air photo mosaics where orthophotos are not yet available which use the same map key as the orthophotos. This land use data can, therefore, be accessed in the same way as other resource information.

Keyed to each property there is additional information on livestock, land ownership, labour and other development information. Some of this data will be generally available, but some is of a confidential nature and will only be made available in aggregated form.

Having this information available in District Offices will enable the D.A. to put together quickly many facts about a farm. When he is talking to the farmer, he will be familiar with the farm and, therefore, better able to advise the farmer.

Land use in agriculture varies each year. Land which has been cultivated in one year will remain capable of cultivation for some years and the location of this land is useful information for some years. There are many uses, however, for current information on land use each year.

One of the large parts of preparing a land use inventory is the preparation of the base maps on which the data is recorded. As these have been prepared for the 1979 survey, new information can be added with much less effort than was necessary for the original survey. The 1979 survey was done by having people interview each landowner. While this type of survey can collect a wide variety of information, it is possible to update much of this information using aerial photographs. Investigations are now underway to determine the possibilities of having the necessary photography flown and interpretations done. This investigation is being undertaken with the cooperation of the Canada Center for Remote Sensing, the University of New Brunswick and the private sector.

9.3 Regional Information

This section discusses the type of information that could prove useful to the regional extension co-ordinators and their staffs in developing new programs and development initiatives for their regions.

Copies of all maps and reports referred to in the section on district information should also be available in regional offices.

Regional development requires economic interpretation which combines the bio-physical resource data referred to so far in this report with socio-economic data. This includes analysis of the existing agricultural activity in a region and the potential for development of the existing resource base by the farmers of the district.

In addition to data already referred to, which will provide background information, evaluations of the economic viability of the existing farms of the region. This will be done by combining existing information with the knowledge of the agrologists familiar with the area. While the situations of individual farms would be examined, the confidentiality of the data would require that only aggregated regional data be made available.

This process of appraising regional agricultural development potential will produce maps and reports which classify the potential for various parts of a region for the expansion of economically viable agriculture. This type of appraisal will be very practical in nature, referring to the immediate as well as longer range potentials. It will consider the potential of existing farms as well as for new farms. The regions will be divided into six classes:

1. Areas where good quality economically viable farm operations now exist. Farmers in these areas, on average, are good managers and likely to make good use of new investment.

2. Areas of medium quality agriculture where farms, on average, are economically viable but not high income earners but where the natural resource base exists which would allow for the raising of incomes with good management and increased investment.

3. Areas where some farms may be economically viable but not high income earners but where the resource base has constraints which would make expansion difficult. While good management and investment might keep agriculture alive in these areas, the resource constraints would limit the potential for increases in incomes from new investments.

4. Areas of poor quality agriculture which does not provide good incomes and where farms have either been abandoned or continue to operate on part time bases where operators must have off-farm to continue. The resource bases of these areas have constraints which cannot be overcome under present technological and economic conditions and are unlikely to respond to investments.

5. Areas where agricultural activity does not presently exist and do not have potential.

6. Areas where agricultural activity does not presently exist but which has soils of the quality suitable for agriculture.

This information should be useful at both regional and provincial levels. The uses will be expanded on in the next section.

9.4 Information For Provincial Policy Planning

The basic problem facing both the private and public sectors is how best to use scarce resources, both natural and financial, to achieve the greatest returns on investments. The number of investment opportunities and the number of producers requesting assistance with expansion of their farms far exceeds the financial resources available. The achievement of the best return on investment in natural resources, whether it be private or public, requires that investment be made where the greatest potential exists. The determination of the location of the areas of maximum potential can only be achieved when the necessary data has been analysed by competent professionals. This analyses must arrive at both overall policies which lead to development strategies and specific policies related to development programs.

The following list refers to some of the programs where a resource information is required. This list is for illustration only and is not intended to be all-inclusive. One of the questions which should be answered in developing these policies refers to the location of resource potential. Where in the province would the greatest return be achieved from investment in:

a) the installation of tile drainage?
b) the construction of erosion control works?
c) marshland reclamation and land forming?
d) the improvement of underutilized cleared land?
e) the clearing of forest land for agriculture?
f) land consolidation activities?
g) farm expansion and new buildings, machinery etc.?
h) increased farmer training?
i) improving transportation networks?
j) improving storage and handling facilities?
k) improving farm supply facilities?
l) improving farmer advisory services?
m) and many other parts of the agriculture - food production process?

These questions, and many others, require answers daily and the better the quality and quantity of information being used, the better the answers will be and the better will be the return on the effects being expended.

9.5 Information For Federal-Provincial Co-operation

Many of the programs related to resource development in New Brunswick are carried out co-operatively between the provincial and federal governments. Some of the areas where an improved information system could assist this process include:

1. Establishing the requirements and priorities for development activities, and for preparing proposals for joint funding activities;

2. Monitoring the effects of programs being carried out, and

3. Evaluating the success or lack of success of these programs and preparing altered programs to better achieve the objectives.

10. SUMMARY

The need to provide accurate response to increased demands in technical aspects of resource development has shown increases in the volume of resource information. This has necessitated a review of the uses of this type of information in agricultural development planning. The full potential of this information now becoming available will only be realized if the information is fully disseminated to as many potential users as possible in a format they can understand and use.

This paper has presented a framework for the handling, dissemination and use of natural resource information. Many details remain to be worked out at all stages of these processes. No attempt has been made at this time to fill in these details. This has been done deliberately as many decisions about details will fall into place as the process continues, so long as there is a framework upon which these details can be hung.

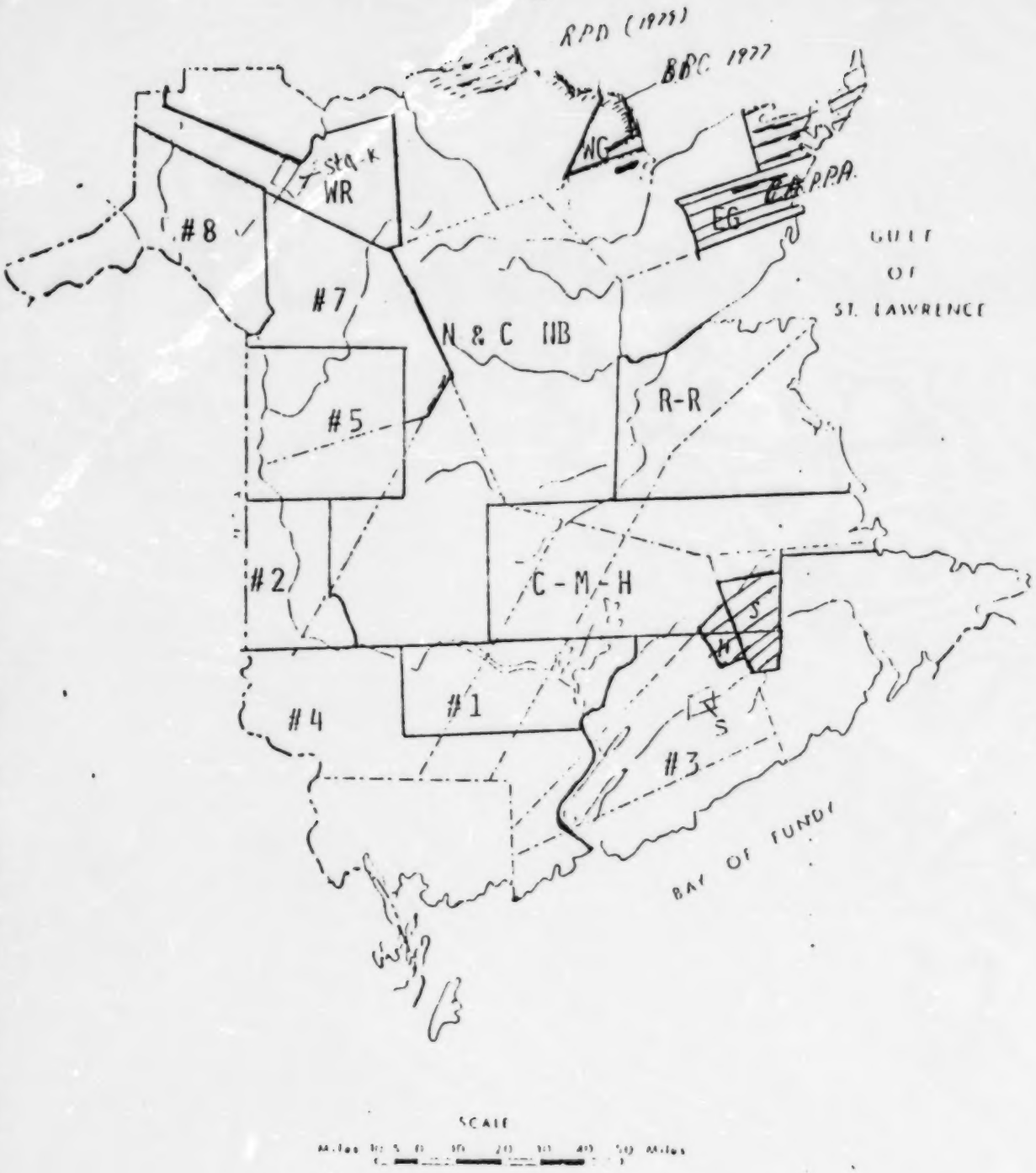
In order to obtain the most efficient procedures for information, handling it will be necessary to evaluate the facilities of different agencies and their capabilities to handle natural resource data. The optimum procedure may vary with the particular type of data and over time as technological developments occur. For this reason, it is proposed that while a policy framework should be agreed upon and used as a guideline, considerable flexibility be left to develop the most efficient procedures for carrying out the policies.

The development strategies of the New Brunswick Department of Agriculture and Rural Development both by itself and in federal-provincial agreements call for increases in production, income, employment and general community well-being. These must be achieved by the most efficient use possible of the natural resources on which the industry is based. Any industry depending on imports for its continuation can never be as sure of its future as one which uses its own resources, nor can any province depending on importation of large proportions of its food ever be sure of its future. It is felt that the policy proposals presented in this paper can assist in improving the future prospects of New Brunswick agriculture and the provincial well-being.

APPENDIX A - SOIL INFORMATION

	Map Code	Name	Date Surveyed	Date Published	Scale
A.	Federal Soil Survey Reports				
	1.	Fredericton-Gagetown	1938-39	1940	1: 96,040
	2.	Woodstock	1939	1944	1:126,720
	3.	Southeastern N.B.	1940-42	1950	1:126,720
	4.	Southwestern N.B.	1943-49	1953	1: 63,360
	5.	Andover-Plaster Rock	1947-52	1964	1: 63,360
	6.	Tobacco soils	1960	1964	--
	7.	Northern Victoria County	1948-61	1976	1: 63,360
	8.	Madawaska	1953-65	In Print	1: 50,000
B.	Areas Surveyed but not yet published				
	WR	Western Restigouche	1955-date		
	WG	Western Gloucester	1963-1966		
	EG	Eastern Gloucester	1963-1967		
	C-M-H	Chipman-Minto-Harcourt	1965-1966	1981-82	1: 50,000
	RR	Rogersville-Richibucto	1973-1976	1980-81	1: 50,000
	N & C NB	Northern & Central N.B.	1977-		1:250,000
	S	Sussex	1978-	198?	1: 20,000
C.	Provincial Surveys				
	BPC	Belledune Planning Commission	1977	1977	1: 25,000
	RPC	Restigouche Planning Commission	1978	1979	1: 25,000
	CAPPA	Peninsula Planning Commission	1976 - Continuing		1: 10,000
	ST.QK	St. Quentin-Kedgwick	1979 - Continuing		1: 50,000

Data as of November 1979



Approximate smallest area that could be shown using different scales:

1:63,360	20 acres	1:10,000	.5 acres
1:96,040	45 acres	1:20,000	2 acres
1:126,720	80 acres	1:50,000	12 acres
1:250,000	240 acres		

APPENDIX B - CLIMATOLOGICAL INFORMATION

This list summarizes all currently available climatic data and/or information which have been developed for specific purposes or are likely to be useful in agriculture.

New Brunswick Department of Agriculture

Recent Publications

Corn Heat Unit Tables for ^{o}F or ^{o}C Daily Temperatures

New Brunswick Weekly Weather Summary, May - September, 1972-1979

Farm Weather Survey, May-September, 1979

Unpublished Data/Information

Daily Heat Unit Normals for New Brunswick, 1941-70

Climatic Water Balance Normals for New Brunswick, 1941-70

Estimated Frost Data Normals for New Brunswick, 1941-70

Agroclimatological Data Collected at N.B.D.A. Climate Station, 1975-79

Report on the Climatic Capability for Agriculture, Kent County, New Brunswick

Report on the Impact of Insufficient Rainfall on Grass Production in Northern New Brunswick, 1976

Report on a Climatic Comparison of Greenhouse Energy Costs in New Brunswick

Report on the Climatic Influences on Fruit and Vegetable Production in New Brunswick

Publications in Preparation

Heat Units for Corn in New Brunswick
- A User's Guide to C. H. U. Normals Mapped on a Toposcale of 1:250,000

An Agroclimatic Survey of Havelock Parish, New Brunswick
- A Report of a Detailed Agroclimatic Pilot Study of the Region Which may Include Analyses of Freeze Risk, Heat Unit Probabilities and Climatic Water Balance.

An Agroclimatic Survey of Eastern Gloucester County (C.A.P.P.A.)
- A report describing agroclimatic variability in the region with emphasis on moderating influences of large water bodies on the temperature regime.

Canada Department of Agriculture

Spring Field Workday Probabilities for Selected Sites Across Canada 1978

Risk Analyses of Weekly Climatic Data for Agricultural and Irrigation Planning 1968 Fredericton, New Brunswick

Risk Analyses of Weekly Climatic Data for Agricultural and Irrigation Planning 1968 Moncton, New Brunswick

Risk Analyses of Weekly Climatic Data for Agricultural and Irrigation Planning 1968 Saint John, New Brunswick

Agroclimatic Maps for Canada
Derived Data: Moisture and Critical Temperatures Near Freezing 1974

Spring Field Workdays in the Atlantic Provinces 1978

Monthly Agmet Report for Fredericton C.D.A. Station

Growing Degree Days and Crop Production in Canada 1977

Temperatures in the Spring and Fall in the Atlantic Region 1975

Atlantic Committee on Agrometeorology

Heat Units for Corn in the Maritime Provinces

Department of Transport

Canadian Meterological Memoirs 1960

Atmospheric Environment Service

New Brunswick Weekly Weather Summary

Airport Weather Summaries (Monthly)

Soil Temperature Data

Climatic Perspectives (Weekly)

Climatic Normals

Climatic Precipitation

Climatic Temperature

Climatic Wind

Climatic Humidity

Climatic Sunshine, Cloud, Pressure and Thunderstorm

Daily Climatological Data Fredericton, N.B.

Degree Days for the Atlantic Provinces

Tables of Daily Degree Days Above or Below any Base Temperature

Frost Data (1941-1970) by G.M. Hemmerick and G.R. Kendall

Daily Bright Sunshine (1941-1970) by B.J. Yorke and G.R. Kendall

Normal Freezing and Thawing Degree Days for Canada (1931-1960) by D. W. Boyd

Winter Snowfall Averages and Extremes at Synoptic Observing Stations by F.D. Manning

An Analysis of Solar Radiation Data for Selected Locations in Canada by J.E. Hay

The Tourism and Outdoor Recreation Climate of the Maritime Provinces by A.D. Gates

Handbook on Agricultural and Forest Meterology Ed. R.A. Triedl

Agroclimatic Atlas of Canada

Monthly Record